PATENT SPECIFICATION 874,041

DRAWINGS ATTACHED.

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COMPLETE SPECIFICATION.

A Method of and Apparatus for Manufacturing Slide Fasteners and Slide Fasteners Produced by the said Method and Apparatus.

We, LIGHTNING FASTENERS LIMITED, a British Company, of Imperial Chemical House, Millbank, London, S.W.1, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention has reference to a method and apparatus for manufacturing slide fasteners and similar articles comprising toothed strips, and to slide fasteners and such articles produced by the said method and apparatus.

The principal object of the present invention is to enable toothed strips comprising components of slide fasteners to be manufactured from thermoplastic material in a simple, expedient and substantially continuous manner.

According to one aspect of the said invention, a toothed strip is manufactured by a method comprising heating a thermoplastic material (as hereinafter defined), injecting the heated material into registering interconnected pocketed rebates formed in and around the peripheries of the adjacent faces of a pair of dies which are rotating about relatively inclined and intersecting axes, and removing the strip from the dies.

The words "thermoplastic material" are used in this Specification and in the appended claims to mean a material which when heated to a suitable temperature is molten or has such degree of plasticity as to be mouldable, but which when subsequently cooled to normal atmospheric temperature becomes comparatively hard, the material nevertheless at this normal temperature possessing a degree of flexibility permitting the manufactured toothed strip to be bent repeatedly without fracture, such bending being necessary, for example, when a slide fastener of which the strip is to form part is opened and closed.

Suitable thermoplastic materials include those in the nylon range of synthetic resins, these nylons having the desirable property of changing from a hard to a molten condition when heated through a critical heat transfer range of the order of up to or about 5° C., the temperature values of this critical range being above the boiling point of water and therefore well above normal atmospheric temperatures.

The invention further consists in apparatus for manufacturing a toothed strip, comprising a pair of dies formed in and around the peripheries of their adjacent faces with pocketed rebates, said dies being synchronously rotatable about axes which are relatively inclined so that said faces make contact with one another at an injection zone and are spaced apart by a maximum distance at a stripping zone substantially diametrically opposed to said injection zone, and a shoe having a concave face contacting the dies at the injection zone, the said maximum distance being greater than the maximum thickness of a strip made in the apparatus, and a passage opening through the shoe to the rebates.

Hence, thermoplastic material may be injected through the passage into the rebates as they travel through the said injection zone and the strip made in the apparatus may be separated from the dies at the stripping zone.

[*Price*

The length of the shoe from the passage to its trailing end, that is measured in the direction which the rebates follow during rotation of the dies, in such that the thermoplastic material will have hardened by the time it has been carried beyond the shoe by the dies. This length is dependent upon the nature of the material and the rotational speed of the dies, but if desired the dies and/or the shoe can be cooled by extraneous means, for example by circulating coolant through passages in the shoe. If the dies are formed with continuous rebates so that the teeth formed in the pockets are connected by a strip moulded in the rebates, the shoe may be provided at its leading end with a rib which enters these rebates and prevents material being injected into the pockets before they arrive at the injection point in the injection zone.

However, if desired the die rebates may be discontinuous, so that each rebate forms part of the stem of the tooth formed in the corresponding pocket, in which case the shoe may be formed with a groove extending from the passage to the trailing end, which groove co-operates with the dies and moulds a continuous strip connecting the teeth which are moulded in the pocketed rebates.

It is envisaged that two general forms of slide fastener may be made using toothed strips made by the method and/or in the apparatus above referred to. A first of these forms comprises a pair of identical strips each consisting of generally symmetrical T-shaped or headed teeth of substantially uniform thickness projecting from the strip with the heads of the T's parallel to and spaced from the strips, these strips being sewn or otherwise secured into bifurcated tapes (as hereinafter defined) so that when the fasteners are closed each head, except end heads, on one strip lies in a space bounded longitudinally by the stems of two adjacent teeth of the other strip and bounded laterally by the heads of these teeth on the one hand and by the said other strip on the other hand; and secondly one comprising strips of which one is the mirror image of the other.

The first form referred to above requires the use of bifurcated tapes which are of substantially Y-section, the strips being secured in the bifurcated part of the Y and the arms of the bifurcation being of such length that when the slide fastener is closed ones of the arms overlap others of the arms and thereby prevent disengagement of the teeth by relative movement in a direction normal to the median plane of both strips.

However, the second form, with which bifurcated strips are only optional, necessitates the use of left and right handed toothed strips which may be made by using the dies first with one of them out of phase with the other by a small angle and then using the dies out of phase to an equal but opposite degree.

Alternatively, in a preferred construction, two sets of dies are used to produce the two strips and each strip has teeth which whilst generally of T-shape are modified so that the leading end of each T-shape, that is the end nearest one particular end of the fastener which may be a permanently closed end, has its thickness reduced to a half by a step cut out of one face and, additionally, has a web located in the angle between the stem and head at the trailing end of the head, the thickness of the web being half that of the head and the web being located on the same side of the median plane of the strip as that on which the step is cut out. With strips having teeth of this form each step on the teeth of one strip abuts a corresponding web on a tooth of the other strip when the fastener is closed so as to prevent disengagement of the teeth by relative movement in a direction normal to the said median plane.

One manner of carrying the invention into practice will now be described with reference to the accompanying drawings wherein:—

Figure 1 is a diagrammatic part-sectional plan of apparatus for producing toothed strip for slide fasteners;

Figure 2 is a cross-section of the apparatus shown in Figure 1, this figure also being diagrammatic;

Figure 3 is an enlarged sectional view of part of the apparatus; and

Figure 4 is a view showing two toothed strips produced in the apparatus of Figures 1 to 3 part-engaged.

The apparatus shown in the drawings, and more particularly in Figures 1 and 2 thereof, comprises a pair of dies 1, 2, which are both circular and are mounted on shafts 3, 4, respectively, the axes A, B, of the shafts being inclined to one another and intersecting one another so that the dies make contact along an injection zone generally indicated by the arrow 5, Figure 2. The peripheries of the dies diverge from one another from the said zone and are spaced apart by a maximum distance which is slightly greatly than the maximum thickness of the strip measured axially of the dies at a stripping zone diametrically opposite to the injection zone and generally indicated by the arrow 6. The dies are, during manufacture of strip, rotated synchronously in the direction of an arrow 7.

Each die has a continuous peripheral rebate or groove 8 in its face adjacent the other die, and these grooves are of similar

dimensions and are registered with one another at the injection zone.

A number of regularly spaced pockets 9 open from each rebate, the shape of each pocket being complementary to that of a corresponding half of a tooth which is to be moulded therein. The pockets in the two dies are in phase with one another.

An injection moulding machine is associated with the dies and is provided at its nozzle end adjacent the dies with a shoe 10. The shoe has a rib 11 which is located in the groove formed at this zone by the two rebates, the rib extending from a passage 12 which opens through the shoe to the leading end thereof.

The trailing end of the shoe extends beyond the zone 5 for a sufficient distance, having regard to the expected rate of rotation of the dies and of the cooling rate of the material, to ensure that a plastic material injected into the pockets 9 will have hardened by the time it is carried past the said trailing end of the dies, the shoe being maintained in contact with the dies over its whole length or being spaced from the dies by a minimum clearance over this length.

The injection moulding machine, which may be of any suitable kind, preferably has a barrel 13 which is axially aligned with the passage 12 and is connected therewith by a tapering portion 14, the barrel being surrounded by a heater 15 and having any convenient means, such as an Archimedes screw for forcing thermoplastic material through the barrel and hence through the passage.

In use the rotating dies carry consecutive registered pockets into the injection zone and thermoplastic material injected therein fills the pockets and forms a continuous strip 16 connecting the teeth formed in the pockets. The toothed strip is stripped from the pockets and rebates by the action of the dies as they rotate, and the strip is withdrawn tangentially of the dies from the zone 6, being wound upon a drum or severed into lengths as required. If desired, a guide may be inserted into the gap between the dies to facilitate removal of the strip.

The preferred form for the teeth is illustrated in Figure 4; as shown therein, each tooth comprises a stem 17 extending normally of the strip and a head 18 extending parallel to the strip, the whole of the tooth being of substantially the same thickness as the strip.

The leading end 19 of each head 18, as the strips are flexed to take the heads into engagement during closing of a fastener, is of half of the thickness of the strip so that a step is formed on each of the said leading ends. A web 20 also of half of the thickness of the strip and having a curved edge is located in the angle between the trailing end of each head and the stem.

The webs are located on the opposite side of the median plane of the strip to that on which the leading ends 19 lie and the faces of the webs and leading ends make contact in the median plane common to both strips when the latter are assembled as shown in Figure 4. Furthermore, the leading ends and webs of both assembled strips lie on the same side of the median plane, one being the mirror image of the other and two sets of dies being needed to produce the two strips. However, the abutment of the faces prevents disengagement of the respective teeth if the closed fastener is flexed in a direction normal to the median plane common to the strips, since instead of each tooth moving independently of the other during such flexing each tooth pivots about the next adjacent tooth maintaining the webs and leading ends at least in linear contact.

It is to be noted that the stems 17 are longer than the heads 18 are wide, so that spaces 21 exist in the closed fastener. These spaces permit the strips to be sewn into tapes or other material without running the risk of the stitching being damaged when the fastener is closed.

WHAT WE CLAIM IS:—

1. A method of manufacturing a toothed strip comprising heating a thermoplastic material, injecting the heated material into registering interconnected pocketed rebates formed in and around the peripheries of the adjacent faces of a pair of dies which are rotating about relatively inclined and intersecting axes, and removing the strip from the dies.

2. A method as claimed in Claim 1, wherein the strip is removed from the dies at a position in their rotation at which they are separated.

3. A method as claimed in Claim 2, wherein the strip is withdrawn tangentially from the dies at a position diametrically opposite to the position at which the material is injected.

4. A method is claimed in any of Claims 1 to 3 wherein the thermoplastic material is nylon.

5. Apparatus for manufacturing toothed strip comprising a pair of dies formed in and around the peripheries of their adjacent faces with pocketed rebates, said dies being synchronously rotatable abut axes which are relatively inclined so that said faces make contact with one another at an injection zone and are spaced apart by a maximum distance at a stripping zone, substantially diametrically opposite to said injection zone, said maximum distance being

greater than the maximum thickness of a strip made in the apparatus, and a shoe having a concave face contacting the dies at the injection zone, a passage opening through the shoe to the rebates.

6. Apparatus as claimed in Claim 5 wherein the said rebates are continuous so that teeth moulded in the pockets are connected by strip moulded in the rebates, and wherein the shoe is provided with a rib located on the leading side of the passage, which rib enters the rebates and prevents material being injected into pockets before they reach the said passage.

7. Apparatus as claimed in Claim 5 or Claim 6 which further comprises an injection moulding machine provided with the said shoe on its end adjacent the dies, said machine having a barrel aligned with the passage and having means for forcing thermoplastic material through the barrel and passage so as to inject the said material into the dies.

8. A toothed strip made by the method claimed in any of Claims 1 to 4.

9. A slide fastener comprising at least one strip made by the method claimed in any of Claims 1 to 4.

10. A toothed strip made in apparatus as claimed in any of Claims 5 to 7.

11. A slide fastener comprising at least one toothed strip made in apparatus as claimed in any of Claims 5 to 7.

12. A slide fastener comprising a pair of toothed strips made by the method and/or in the apparatus as claimed in any of Claims 1 to 7, wherein the strips are identical and comprise generally T-shaped or headed teeth of uniform thickness with the heads of the T's parallel to and spaced from the strips.

13. A slide fastener as claimed in Claim 12 wherein the strips are sewn or otherwise secured into bifurcated tapes.

14. A slide fastener comprising a pair of toothed strips made by the method and/or in apparatus as claimed in any of Claims 1 to 7, wherein the strips are mirror images of one another.

15. A slide fastener as claimed in Claim 14 wherein one of the strips is made in apparatus in which the dies are out-of-phase by a small angle and the other of the strips is made in the same or similar apparatus in which the dies are out-of-phase by an equal and opposite angle.

16. A slide fastener as claimed in Claim 14, wherein each tooth of each strip is of generally T-shape, with a step cut out of one face of one end of the head and a web located in the angle between the other end of the head and the stem of the T.

17. A method of making toothed strip for slide fasteners substantially as hereinbefore described.

18. Apparatus for making toothed strip for a slide fastener substantially as hereinbefore described with reference to and as shown in Figures 1 to 3 of the accompanying drawings.

19. A toothed strip for a slide fastener made by the method claimed in Claim 1 and substantially as hereinbefore described with reference to and as shown in Figure 4 of the accompanying drawings.

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Agent for the Applicants.

PROVISIONAL SPECIFICATION.

A Method of and Apparatus for Manufacturing Slide Fasteners and Slide Fasteners Produced by the said Method and Apparatus.

We, LIGHTNING FASTENER LIMITED, a British Company, of Imperial Chemical House, Millbank, London, S.W.1, do hereby declare this invention to be described in the following statement:—

This invention has reference to a method of and apparatus for manufacturing slide fasteners, and to slide fasteners produced by the said method and apparatus.

The principal object of the present invention is to enable the toothed strips which comprise the essential components of a slide fasteners, to be manufactured from a thermoplastic material in a simple, expedient and continuous manner.

In accordance with the said invention, a toothed strip for use in the construction of a slide fastener, is manufactured by a method which comprises heating a thermoplastic material in an extrusion machine, extruding the heated material into registering pocketed rebates formed in and around the peripheries of the adjacent faces of a pair of rotating dies removed from the said machine.

Preferably, the material consists of one of the nylon range of plastics or equivalent thermoplastic material, that is to say, a material which does not tend to soften until heated to a temperature above the boiling point of water but is adapted to be changed from a normal hard and tough condition to a molten condition over a short critical heat transfer range of, for example, not more than five degrees centigrade.

Apparatus for carrying out the said

method comprises, in accordance with the said invention, an extrusion cylinder for heating the thermoplastic material to a temperature above melting point, having a discharge nozzle which opens to the concave face of a cylinder shoe, and a pair of circular dies of which the peripheries seat upon the said shoe face, each die being rotatable about its axis and the die axes being so relatively inclined that their adjacent and peripherally rebated and pocketed faces are in contact with one another at the cylinder nozzle but are spaced apart at a position diametrically opposed to the nozzle by a distance not less than the sum of the axial dimensions of the rebates.

Due to the formation of the registering peripheral rebates in the adjacent die faces, a channel, which opens to their peripheries, is formed between the two dies, and, preferably, the shoe face is provided on one side of the nozzle, with a shoulder or rib which makes a sliding fit within the said channel, the dies being rotatable in the direction such that their contacting faces travel past the shoulder before reaching the nozzle.

Each of the dies is formed with the same number of pockets which are pitched equidistantly apart around the base of the corresponding rebate; each pocket opens to the base of the said rebate from where it extends radially inwards and opens to the face of the corresponding die, and may be of the same axial dimension as the rebate bases. The pockets in the one die may be of T-shape as viewed from the die face, the heads of the T's being located at the radially inner ends of the respective pockets. On the other hand, each of the pockets in the other die may have one flat side wall whereas the other and opposite side wall may comprise a concave portion which extends between a shallow flat portion at the radially outer pocket end opening to the rebate base, and a deeper flat portion of the same depth as the head of the T-shaped pockets in the said one die; in such circumstances, the said radially outer ends of the pockets are preferably of the same dimension circumferentially of the circular rebate bases and the radially outer end of each pocket in the one die registers with the radially outer end of the corresponding one of the pockets in the other die, thereby forming in the base of the inter-die channel, a number of identical ports which are pitched equi-distantly apart across the concave shoe face. Further, it is desirable that the concave side wall portion of each of the pockets in the said other die should be of such a radius and depth that the deeper flat portion is in the same plane as one end of the head of the corresponding T-shaped pocket in the said one die.

Hence, as the dies are rotated and molten thermoplastic material is extruded from the cylinder nozzle into the inter-die channel, it will fill the channel on the leading side of the shoe shoulder and flow through the channel ports in succession and fill the corresponding two registering die pockets thereby producing a toothed strip of thermoplastic material which cools and freezes as it is formed and before it travels beyond the concave shoe face, each tooth assuming the shape of the interiors of the said two registering pockets.

Since the toothed strip is formed initially and continuously from the molten material and freezes as the dies rotate at the same constant speed about their relatively inclined axes, the frozen strip will be free from internal stress and even when composed of one of the nylon range of plastics which are of an abrasive nature, is produced without any appreciable tool wear.

As the dies carry the frozen toothed strip beyond the cylinder shoe their adjacent faces part gradually so that the teeth are stripped from their respective pockets until, when the strip has been carried through one hundred and eight degrees from the cylinder nozzle, it is located in the maximum inter-die clearance and may be fed tangentially from between the dies and wound upon a drum or severed into units of any predetermined length. If desired, a guide may be inserted in the said clearance to ensure that the strip is removed from between the dies.

The invention further consists in a toothed strip for a slide fastener, comprising a system of identical teeth which are pitched equidistantly apart along one side of the strip, each tooth being of the same width as the strip and being provided with a flange on each of the two opposed sides extending transversely of the strip and on its end remote from the strip, one flange extending across the width of the tooth and the other extending from one end to the centre of the tooth, a projection which is provided on the shank below the wider flange, extending from the opposite end to the centre of the tooth.

Preferably, the flanges are of a depth less than the shanks and the transverse surfaces of the projections are convex and extend from the transverse edges of the wider flanges to the vicinity of the roots of the shanks of their respective teeth.

Thus, by providing two toothed strips on each of which the teeth are reversed in relationship to the teeth on the other strip, feeding the strips towards one another, with their toothed faces adjacent, along curved paths so as to increase the distances between the flanged ends of adjacent teeth on each strip, the said end of each tooth

on the one strip may be passed, in succession, between the flanged ends of two adjacent teeth on the other strip. Subsequently, as the strips move out of the curved paths into straight and parallel paths so as to reduce the said distances, the flanges on the end of each tooth engages wider flanges of the two adjacent teeth on either side thereof so as to lock the two strips together. Furthermore, the projections of each tooth shank overlaps the narrower flange on one of the next adjacent teeth on the other of the two strips thereby locking the two strips against relative transverse movement.

By making the said flanges of a depth less than the shanks of the teeth, a clearance is provided between the flanged end of each tooth on the two interlocked strips, and the portion of the other strip between the two adjacent teeth with which the said end is interlocked; hence, threads may be passed through the clearances to attach the strips to corresponding lengths of fabric.

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from which copies may be obtained.

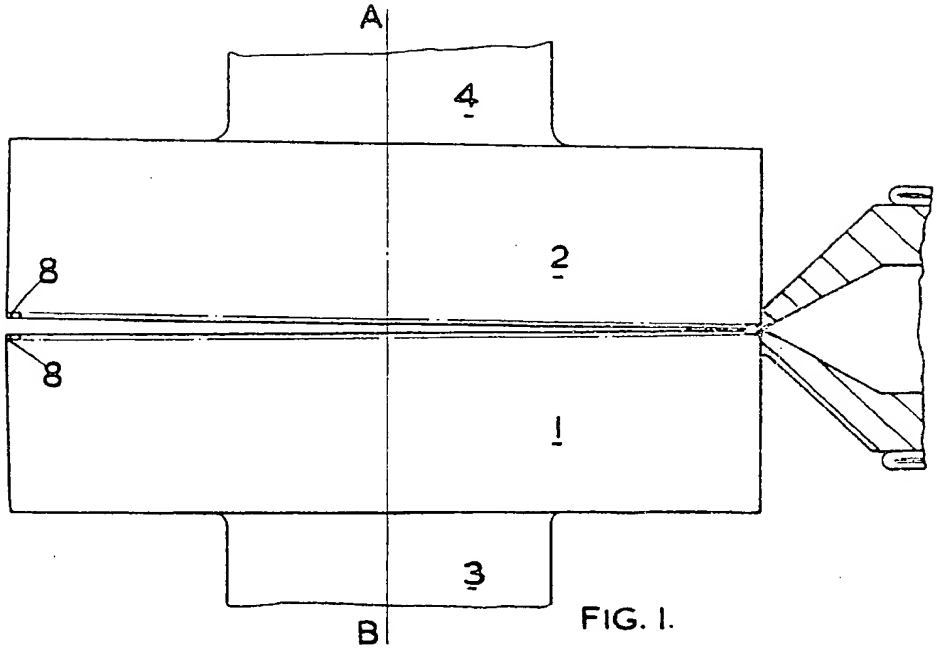

FIG. 1.

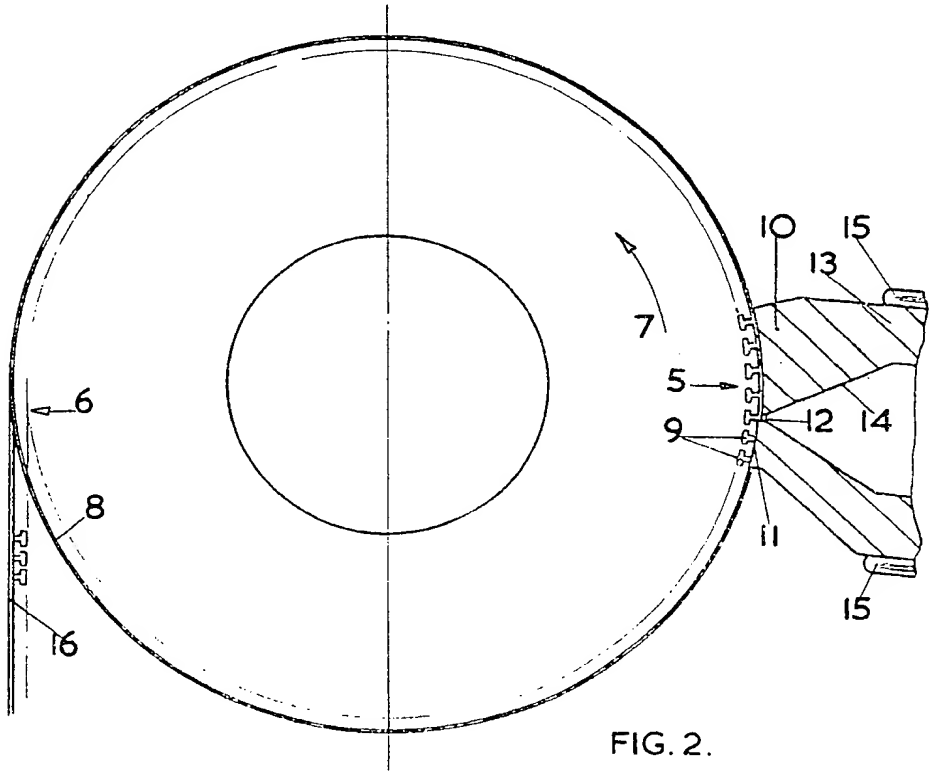

FIG. 2.

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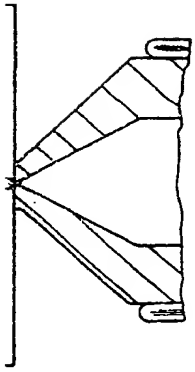
2 SHEETS



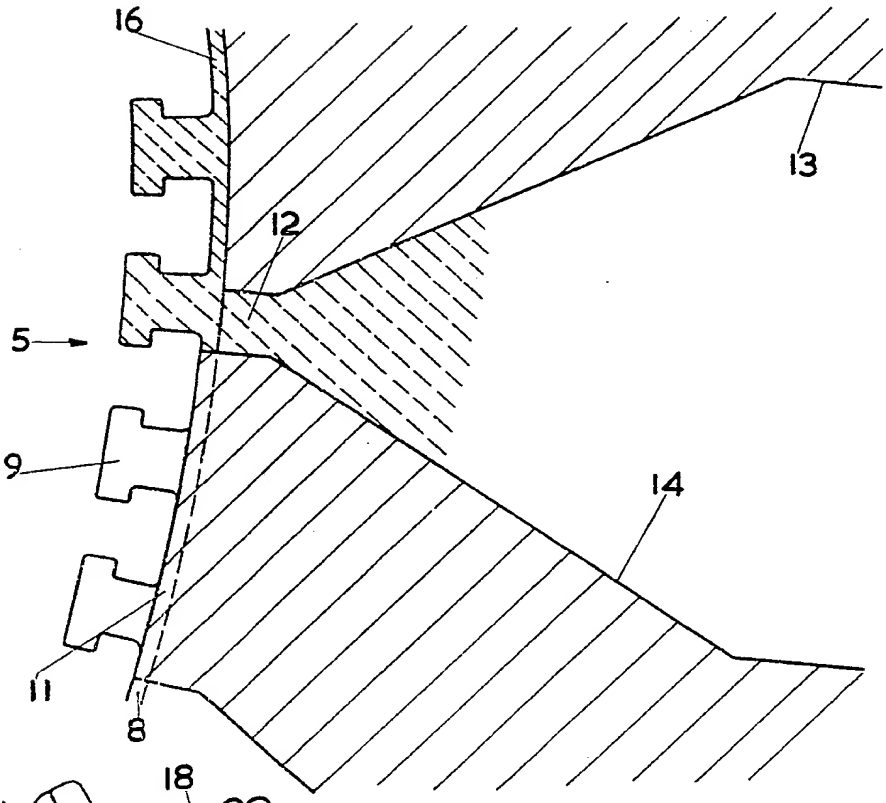
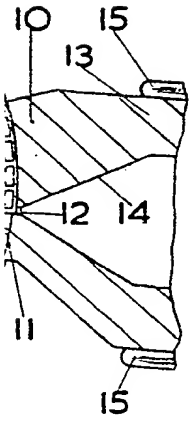


FIG. 3.



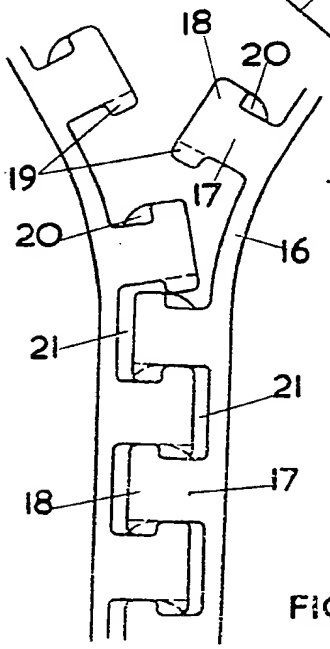


FIG. 4.

874,041 COMPLETE SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale.
SHEETS 1 & 2

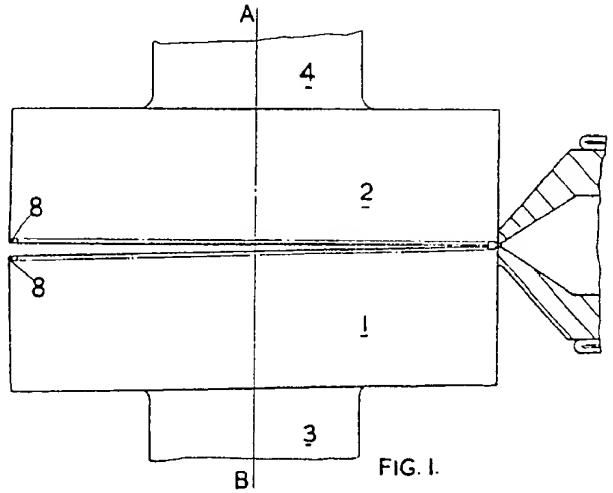


FIG. 1.

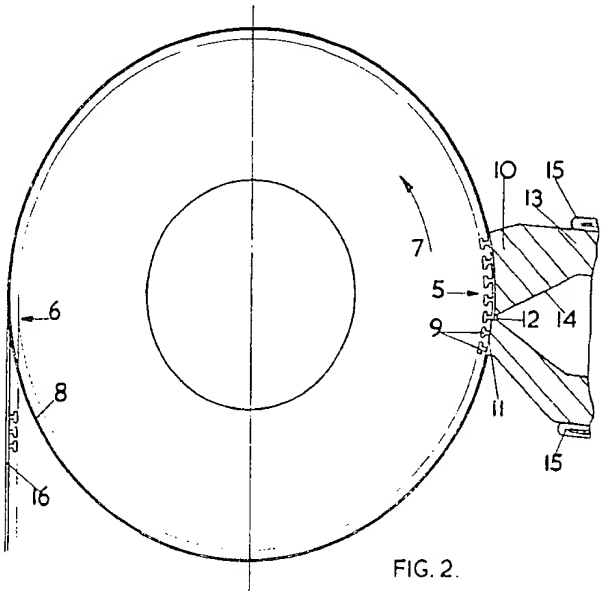


FIG. 2.

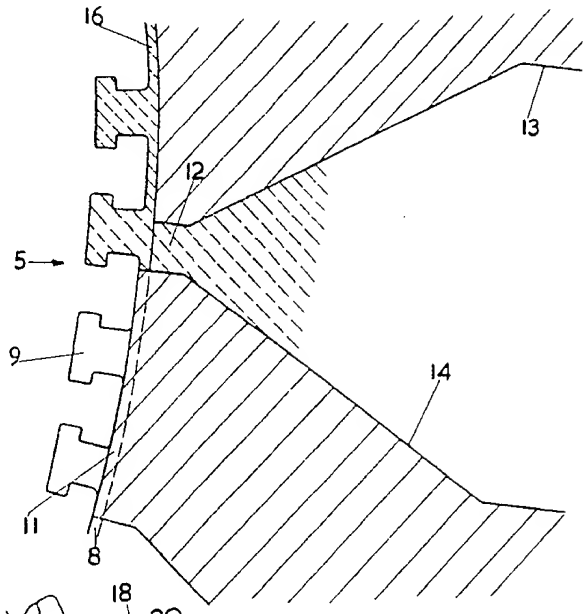


FIG. 3.

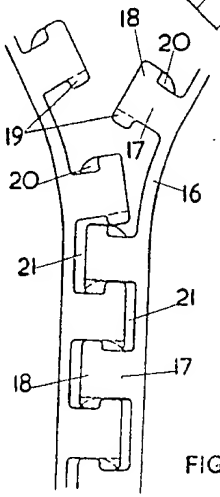


FIG. 4.